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BOTANICAL SKETCHES FROM THE ASIATIC TROPICS

BY HENRY ALLAN GLEASON

IV. CEYLON

(Continued from November, 1915, *Torreya*)

On the afternoon of February 28, 1914, the highest mountain peak of Ceylon broke into our view over the mists northwest across the Indian Ocean. That evening our boat skirted the well-lighted south shore of the island, and before daybreak lay at anchor in the harbor of Colombo. The mountainous character of the interior of the island was visible even from the shore, and the sun rose behind the sharply pyramidal summit of the sacred mountain, Adam's Peak.

Colombo offers no attraction to the botanist, other than the two public parks, Victoria Gardens and Cinnamon Gardens. The latter occupies the site of an old cinnamon plantation. These parks have a fair representation of the more important ornamental species of the tropics, and some of them are labelled with their scientific names. The following morning, March 2, we took the train inland to Peradeniya, the site of the Royal Botanical Gardens.

The first part of the 72-mile ride was not particularly interesting. It is over flat ground, only a few feet above sea level, with a good deal of brackish water, lined with tall grasses and *Pandanus*. Then one reaches low hills, with many rock outcrops and frequent dikes, indicating volcanic activity. We saw one field of rubber and one of cacao, but the commonest

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crops are rice and coconuts. The country is not settled nearly so densely as Java, and the vegetation is by no means as luxuriant. At this dry season of the year, the rice fields are used chiefly merely for pasture. The roadsides are broad, and frequently weedy, the rice fields are generally unkempt, and there are many small areas of unused ground, covered with a jungle of shrubbery or second-growth forest. The country appears to offer much better opportunity for botanical collecting than Java, but in neatness, trimness, and intensive cultivation it is far behind. This is doubtless partly due to the sparser population, and partly



FIG. 28. The Royal Botanical Garden at Peradeniya, Ceylon.

also to the season, for at this time of year there had been virtually no rain for the two months previous, and would be none in these lowlands for over a month afterward.

The little villages, scattered at short intervals along the line, have the usual cultivated plants, coconut, sugar palm, and betel especially. There were the usual tropical weeds, the low tangles of sensitive plant, an herbaceous *Spilanthes*, two species of shrubby *Lantana*, and a species of *Stachytarpheta*, very similar to our American *Verbena hastata*.

At an altitude of 250 feet, the line reaches the first tea plantation, and at Rambukkana, 52 miles out, it leaves the low country

and enters the mountains. The trains make good speed across the level coastal plain, but through the mountains travel at a vexatiously slow rate, even though there are two engines and a maximum grade of 100 feet per mile.

Our train was an hour in covering the next thirteen miles, winding around the sides of mountains and through a dozen short tunnels. The mountain sides, although seldom over 2,000 feet high, are very steep and picturesque, while below the railway lie innumerable rice terraces in the valleys, and more rugged mountains beyond. The highest altitude reached is about 1,700 feet, and in the last few miles the line descends slightly to Peradeniya, at an altitude of 1,550 feet.

The railway branches at Peradeniya junction, and it is less than half a mile on to New Peradeniya. Neither place is a town, or even a village, so far as can be seen from the railway. There is a postoffice at New Peradeniya, chiefly for the convenience of the garden staff, and the station itself is primarily for the convenience of the garden and the numerous tourists who visit it. The nearest city is Kandy, four miles farther on, with probably 30,000 inhabitants.

The Botanical Garden lies about three fourths of a mile north of the station, and is reached by a beautifully macadamized road, lined with huge *Bombax* trees and bordered by tea plantations.

We secured quarters at the government rest-house, directly across the street from the main (and only) entrance to the garden. These rest-houses have been built throughout the island where no hotel accommodations are available, and in this one certain rooms are set apart for the free use of visiting botanists. One must pay five rupees per day for meals, with small extras for fees and baths. The meals can not be very highly recommended, and an American misses ice, which seems to be unknown. Unless it is desirable to spend all the time possible at the garden, visitors will be much more comfortable in the Kandy hotels, at only a rupee or two more per day. There is frequent and convenient train service to Peradeniya, or one can use carriage or rickshaw if he prefers. In the cool of the morning, it is a pleasant walk. In Kandy there are good shops and attrac-

tive scenery, and plenty of English-speaking people as well. There is also a small hotel at Peradeniya Junction, in which we were very comfortable for two weeks, but which requires a two-mile walk or a rickshaw ride to reach the garden.

The Botanical Garden was established in 1821, with Alexander Moon as the first superintendent. The scientific importance of the garden was attained under the long directorship of Dr. Thwaites, who retired in 1880. He was followed by Dr. Trimen, author of the *Flora of Ceylon*. After his death in 1896, Dr. J. C. Willis was appointed director, and retired in 1911.

The garden has an area of approximately 150 acres. It has the shape of a horseshoe, the curving sides of which are formed by the river Mahaweli-ganga, the largest river of Ceylon, while the main wagon road to Kandy forms the other side. Its surface is gently rolling, and is well laid out with numerous carriage drives and footpaths. In the background in every direction rise the mountains, partly covered with second-growth forest, but mainly with tea estates, so that the garden has a particularly charming setting.

The buildings of the garden are few and unpretentious. There is a one-story office building, with the office of the director; a library, containing an excellent collection of botanical references; a museum and herbarium building, containing below museum exhibitions of considerable interest and above a good herbarium; and a general laboratory, one story high and without any adequate provision for visiting scientists. Botanists will in general find better facilities and much better accommodations for any sort of investigation at Buitenzorg.

In general appearance, the garden is strikingly different from the one at Buitenzorg. There are broad lawns, arbors, and flower beds, apparently intended to make the place look as much like a British park as possible. Since the trees are planted farther apart, it is frequently possible to get photographs of individual specimens and of general landscapes. This is usually impossible in Buitenzorg, because the vegetation is too dense. All in all, the garden is much more attractive than Buitenzorg, but not nearly so rich scientifically.

The climate is also radically different from that of western Java. Here the influence of the monsoons is distinctly felt, and there are pronounced wet and dry seasons. With the northeast monsoon, beginning in autumn, most of the rainfall ceases, and each succeeding month is drier, until in February and March practically no rain falls. The southwest monsoon begins in April, after a period of unusually hot weather, and brings the rains. The average rainfall amounts to about 90 inches per year, just about half that of Buitenzorg. The temperature is equable; but not so uniform as in Java. During our stay, the nightly minimum was about 70° , while the maximum was about 90° at one o'clock.

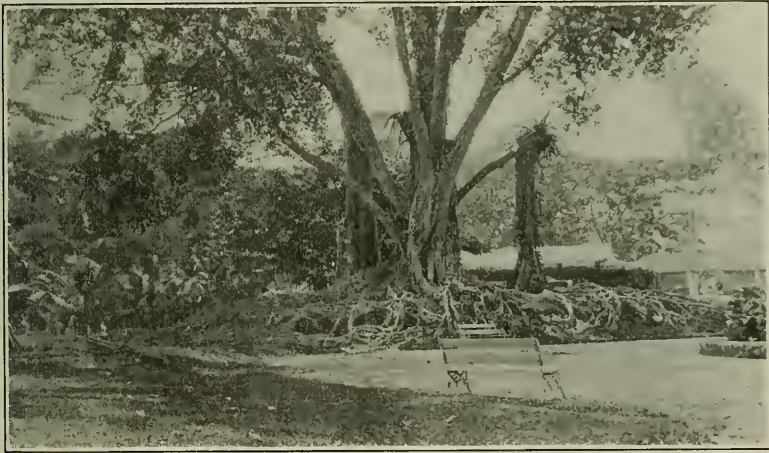


FIG. 29. *Ficus elastica*, with unusual root dependent. Ceylon.

This alternation of wet and dry season has an obvious effect on the vegetation. When we reached the garden, no rain had fallen for more than a month, and none fell during the first five weeks of our stay. As a result, the grass was brown and dry and resembled an Illinois lawn after an August drought. Epiphytes are few, and the epiphytic ferns during the dry season are flaccid and wrinkled, and feel like a rubber band. Many trees show no effects whatever, but there is noticeably a large proportion of species with xerophytic leaves, such as the India

Rubber, *Ficus elastica*. Other species are completely leafless. Many species bloom just at the end of the dry season, so that the display of flowers was particularly brilliant just at the time of our visit. The huge *Bombax* trees along the roadside, completely bare otherwise, have great crimson flowers on the branches, the *Stereospermums* are similarly covered with white flowers, and so for many other species. The garden paths are frequently strewn with red or white or yellow flowers, dropped from some tall tree above.

The number of flowers on some of the trees is almost incredible. There was an average of 25 flowers per square inch under a large tree of *Terminalia bellerica*, covering a space of fifty feet in diameter, and amounting to certainly five million flowers already fallen, to say nothing of those still on the tree. After every breeze the air was filled with them as with yellow snow flakes.

It is not necessary to describe in detail the brilliancy of the floral display in the garden, because it is not characteristic of the tropics. Selective planting has emphasized it in the garden, and produced a riot of color, in which scarlet and crimson predominate. Two genera only need be mentioned.

Several species of *Brownea* are planted, producing their scarlet or orange flowers in spherical clusters as much as six inches in diameter, and composed of hundreds of flowers. *Amherstia nobilis* produces its flowers in pendent racemes a yard long. The rachis and pedicels are crimson. On each pedicel are two crimson bracts, each three inches long, and beyond the bracts is a crimson flower with crimson stamens, each petal three inches long. When a hundred or more of these racemes are blooming on a tree the size of an American cherry, the result is remarkably vivid.

Throughout the whole of March and the first few days of April the same weather continued, continuous sunshine, except for the occasional shade from a light fleecy cloud, and a dry piercing heat that seemed to grow more intense every day, until the climax came on April 4. At noon on that day the heat was oppressive. The mountains on the horizon seemed to quiver

through the heated atmosphere. The sky and the white clouds were iridescent. Every plant seemed to show the effect of too great heat, and the pinnac of the coconut leaves were actually drooping. Even the native children, who generally play bare-headed in the open sun, kept in the shade. Still the shade temperature probably did not exceed 95° , although a black bulb thermometer would have registered possibly some 50 degrees higher. At one o'clock the hotel proprietor announced his belief that the monsoon had arrived. By three dark clouds began to travel across the sky from the southwest, and shortly after the



FIG. 30. Ornamental plantings in the Botanical Garden, Peradeniya, Ceylon.

rain fell in torrents. During the remainder of our stay in the island there was a heavy rain every afternoon, and in a very short time the lawns were green and all the trees had brightened up wonderfully. It is quite likely, however, that the improved appearance was due as much to washing away the accumulation of dust as to new growth.

The prevailing habit among the plants of blooming at or near the close of the dry season certainly gives them the advantage of a continuous supply of moisture for the development of their fruits and seeds. It does not appear probable, however, that the habit has been developed as a result of this advantage, but

rather than the continued drought induces the flowering of the trees and shrubs. Herbaceous plants frequently die during the dry season, and new shoots and flowers appear after the opening of the rainy season.

Entering the garden by its main entrance, the visitor follows the main central drive, almost half a mile long. Its continuity is interrupted by an island of palms just within the entrance and another half way down the drive. It is bordered by dense plantings of shrubbery in some places and by open lawns in others, so that it lacks completely the magnificence of the Canary Avenue at Buitenzorg. At the farther end, the main drive unites with the river drive, paralleling the shore almost around the garden. The latter offers many interesting views of the river and the mountains beyond, and is shaded by huge clumps of the giant bamboo, *Dendrocalamus*, at least 80 and possibly 100 feet in height. The farther half of the garden is occupied by the arboretum, rather densely planted to trees, but in no systematic order.

There is a small artificial lake, plots for fruit trees, vegetables and spices, a small herbaceous garden, a shaded plot for ferns, aroids, and marantas, experimental grounds, and interesting collections of bamboos, cycads, *Pandanus*, and palms. The residences of the curator and director are near the main road in one corner, and the propagating grounds and work rooms near the road at the other corner. There are throughout the garden numerous interesting plants which the botanist will examine, and the following notes will present some of the observations made by the writer.

Near the laboratory building are several tall and exceedingly slender trees of *Araucaria Bidwellii* and *A. Cooki*. *A. Bidwellii* has drooping lower branches and horizontal ones at the middle and near the summit. Each branch is produced from an obliquely conical knot or protuberance on the trunk, as much as six inches wide. On all the branches, the leaf-bearing twigs are clustered near the apex, and drop off behind, leaving naked branches. The ground beneath the trees is covered with the fallen twigs, some of them as much as five feet long.

The trees always show dimorphic leaves, after the manner of the American red cedar. The larger are nearly two inches long, divaricately spreading, and more or less plagiotropic, forming a flattened spray. The smaller are only half the size, ascending and not at all plagiotropic. One tree of *A. Bidwellii* has on its lower branches about equal numbers of each sort of leaf, arranged in regularly alternating zones, while a second tree produces the larger leaves almost entirely. Towards the top of the tree the proportion of small leaves increases, and the long fallen twigs are composed of them almost exclusively. It is dangerous to hazard a guess as to the cause of the dimorphism, but it seemed that it might represent the effect of the dry season on the shaded branches. At this season at least all the branches were producing the smaller leaves.

There are several magnificent trees of the Kauri pine, *Agathis robusta*, with massive straight erect trunk and smooth grayish brown bark. Some of them have a trunk diameter of six feet, and a height of probably seventy-five feet. Their trunks are strictly excurrent in habit, but are occasionally branched. The branch rises so nearly vertically beside the trunk that it may be ten feet or more from the point of origin to its final separation.

A staminate tree of *Lodoicea seychellarum*, with trunk a foot in diameter and eighteen feet high, was blooming early in March. The spikes of flowers are two feet long, with short projecting clusters of yellow-brown stamens.

There is an excellent specimen of the banyan, *Ficus altissima*, showing in an interesting fashion the production of prop roots. The mature prop roots seldom show any evidence of fusion or branching, at least externally. Yet the young roots before reaching the ground are freely branched, forming a tangled sheaf of slender (2 mm.) rootlets, swaying in the wind, and with their terminal growing points at about the same level. These tips are easily injured, for which reason they are frequently protected by enclosure in a section of bamboo. After they once establish themselves, usually several at a time, fusion takes place, and the growth in thickness must be very rapid, as small prop roots are seldom seen.

Normally these roots are thicker below than above, *i. e.*, on the youngest part. Others may be seen smallest in the middle, and still others irregularly thickened. They are almost invariably straight, either vertical or oblique, and the latter direction is probably caused by the gardeners, who anchor the tips somewhat out of the vertical.

When the prop roots are crowded, the amount of fusion may be very great. For example, two prop roots originate near each other on the same branch, about 35 feet from the ground. They



FIG. 31. Avenue of Palmyra palms, *Borassus flabelliformis*. Ceylon.

are fused for about twelve feet before separation. Ten feet below, they pass on different sides of a lateral branch, and both fuse with it. This branch also produces a prop root, which fuses with both the others, and there are other fusions among the three or their branches near the ground.

The main "trunk" of this banyan is over ten feet in diameter, and the peripheral fusion of the roots which compose it is so extensive and so complete that in many places it is shown only by elliptical cavities, extending through the peripheral root system, and usually more or less filled with termite deposits.

Other species of banyans differ, of course, in the details of behavior. They all agree in providing, on the horizontal

branches and between the fused roots, excellent sites for epiphytes, and the trees are usually pretty well covered with them.

There are numerous giant specimens of other species of *Ficus*, and one species is planted as a shade tree outside the garden. The specimens of this in the golf links near the rest-house have massive trunks, immense spreading crowns, and are probably a hundred feet high.

One of the most interesting displays in the Botanical Garden is made by the two huge trees of India rubber, *Ficus elastica*. The age of these trees is not known, but they have at present a trunk diameter of five or six feet. At the height of about fifteen feet the trunk breaks up into numerous large spreading branches which form a dense crown probably sixty or eighty feet across and about as high. There are not very many prop roots, but those which are present are all of large size and appear close to the main trunk. The larger branches of the tree are well covered with various species of epiphytes, among which is a triangular stemmed cactus belonging probably to the genus *Cereus* which is especially prominent. There are also the smaller epiphytic ferns and a few larger bird's-nest ferns. The leaves on the principal branches are only one half the ordinary size, as we see them on the smaller plants in our greenhouse, but leaves of normal size appear regularly on the rapidly growing stems. At the base of the tree is a huge tangle of horizontal roots extending out in all directions from the tree for a distance of about fifty feet. The thickness of these roots is generally less than a foot but their upper surface is irregular and sometimes at least a yard from the ground.

Trees of the sacred fig, *Ficus religiosa*, are, of course, planted freely in the Botanical Garden and through the whole vicinity. Besides the planted ones, wild trees are seen coming up in many different places. They seem to show an especial predilection for brick or stone walls and even appear occasionally on the roofs of the houses. As is well known, this tree is sacred to the Buddhists and a true Buddhist is not allowed to destroy or injure a tree in any way. Consequently if one of these trees takes possession of a house roof the fate of that house is usually

settled, and one sees frequent instances in Ceylon of piles of rubbish and masonry overgrown with one of these sacred figs, very likely marking the spot where some building formerly stood. We did not see the famous sacred fig tree of Anuradhapura. This tree was planted according to reliable historical evidence in 288 B.C. It is, therefore, now well over 2,000 years old and is one of the oldest trees whose age is accurately known in the world.

The highway near the Botanical Garden is lined by a double row of large *Bombax* trees. They have an appearance not unlike our American ash trees. At the time of our visit they were completely leafless, but they followed the general plan of many other trees of Ceylon and were in full bloom during the month of March. Numerous large crimson flowers four or five inches in diameter appear on the branches and ovoid pods of last year's crop of fruit were still persistent.

The collection of screw pines is interesting and includes several different species. This display seems to be much better than the corresponding one at Buitenzorg. In one species the prop roots make a labyrinthine tangle, as much as fifteen feet high. The dead leaves which seem to fall at regular intervals become tangled among these roots, forming an opaque thatch and shutting off all light from the base of the tree.

There are various trees of the Bignoniaceae planted in the Garden and many of these also bloom at the close of the dry season. In front of the rest house was a small tree of *Jacarandra mimosaeifolia*. As the name indicates, its foliage resembles that of the mimosa and before the flowers appeared we considered it related to that plant. Its flowers appear close to the branches and give the tree an aspect not unlike the American red bud. An unnamed species of Bignoniaceae, leafless at the time of our visit, produces huge flat pods up to a yard in length and four inches wide. These pods generally fell to the ground before discharging the flat-winged seeds. Two species of Legumes were also interesting because of their winged pods. The first of these, *Pterospermum*, has the wing at one side only, but the curving of the pod produces a wing which is almost circular.

A tree of the travellers' palm, *Ravenala madagascariensis*, is at least thirty feet in height to the last leaves and makes a most conspicuous appearance against the background of trees of ordinary foliage.

There is an interesting avenue of the royal palm and another of the related cabbage palm. The trunks of the latter species are so smooth and symmetrical that they appear artificial. The avenue of Palmyra palms, *Borassus flabelliformis*, is very picturesque. As the leaves fall off with old age, the persistent leaf bases make a very rough trunk. They point alternately in opposite directions. Each leaf base extends over one half the diameter of the trunk, but the expansion of the trunk splits it at the base into two halves, each half attached to the opposite side of the tree and with the wood fibers ravelled out on the split edge. As the palm tree grows still older, the leaf bases also fall off, leaving the trunk smooth and ringed. These leaves occur in definite spirals, giving a conspicuous screw-like appearance to the trunk. Both left-handed and right-handed spirals occur in approximately equal numbers. The avenue of the trees exhibited 31 left-handed and 39 right-handed.

The best display of palms which we saw in the tropics was the avenue of Talipot palm, *Corypha umbraculiformis*. These trees were planted in 1885 and already had a trunk diameter of three or four feet, including the persistent leaf-bases. A single specimen of this tree in a different part of the Garden was about seventy-five feet high, with a crown twenty feet in diameter at the top, a straight ringed trunk, and hanging dead leaves at the top fifteen feet long. The young leaves were just appearing at the time of our visit. Terminating this huge tree was the inflorescence, a huge pyramidal cluster of flowers fifteen feet high and of equal diameter, forming a most magnificent display. As is well known, these trees bloom only when forty to sixty years old and they die after flowering. Therefore, the avenue of Talipot palms has only twenty or thirty years more to live.

There is one large specimen of a strangling *Clusia* on a palm tree. It has the general habit of a strangling fig but differs in the detail of its roots. These fuse with each other more freely

and more regularly than the roots of the fig, making a rather symmetrical network along the trunk of the palm. Its leaf branches are now already so large that they shade the leaves of the palm and it would appear that the palm is doomed in a very short time.

The American rain-tree, *Pithecolobium saman*, is planted freely in the Botanical Garden and elsewhere in the vicinity. It seems to flourish just as well as it does in the Philippines but the Ceylonese trees are mostly larger, with more widely spreading convex crowns. Their flowers are about two inches wide in close umbels with numerous exerted stamens. We were interested in observing the sleep movements of this plant. By five o'clock in the afternoon, although the sun is still shining, the stomata are closed but most of the leaves are not yet in sleep position. A few of the leaves at the ends of rapidly growing stems approach the sleep position, but this may be due more to their age. The petiole remains motionless, while the pinnae of the double compound leaf soon begin to drop. Shortly after the stomata have closed, the pinnae reach an angle of forty-five degrees from the vertical. By 5:30 they are only fifteen degrees from the vertical and by six o'clock, one hour after the stomata have closed, they are nearly or quite vertical, bringing the opposite pinnae together. At the same time the leaflets fold upwards so that they bring their upper surfaces together and at the same time point forwards. This condition continues through the night, and by 6:30 in the morning the stomata are again open. At this time the pinnae are still almost vertical and the leaflets not yet unfolded, but in half an hour or an hour more they have returned to their usual daylight position. It will be observed that the movement of the leaf is always preceded by the opening or closing of the stomata and one might suspect that there was some correlation between the two phenomena.

Several trees of the sea-shore tree, *Barringtonia speciosa*, are growing in the garden, where they bear fruit freely, and others are planted along the lake-shore in Kandy. The petals of these flowers are about an inch long but the conspicuous feature of them is the mass of white stamens. These are three inches

long and a single flower may contain more than five hundred of them.

One of the most curious trees in the Botanical Garden is the cannon-ball tree, *Couroupita guianensis*. The trunk of large specimens is almost hidden by a tangle of crooked irregular branches about three feet long, on which the flowers are produced in huge racemes. One cannot say that these flowers are produced along the main trunk, but the flower-bearing branches



FIG. 32. Talipot palm in bloom. Ceylon.

appear there only, so that after all it seems to represent one form of cauliflory. The flowers themselves are interesting in their structure but the tree is especially conspicuous because of its huge spherical fruits up to a foot in diameter and greatly resembling the object for which the tree is named.

There is an avenue of canary trees, *Canarium commune*, which exhibits the best but not the largest buttresses that we ever saw. These appear on the sides of the trunk, as much as twenty feet above the ground, as thin triangular outgrowths three or four feet high, four inches thick, and projecting one or two feet. Most of these have a thickened place below as if the buttress was forming about a broken or a pruned branch. This is probably the case, as one was seen twenty feet up the tree with a branch scar already partly covered with callus; other lower branches frequently have the buttresses already formed. These stem buttresses are not necessarily homologous with the basal ones which appear to arise above a root. Those are long, flexuous, thin, branched, and undulating on the top, so that portions of them may be underground and then reappear eight or ten feet out. These buttresses are as much as six feet high at the base and of every conceivable shape and direction.

The upper branches of these canary trees are kept completely leafless by the colonies of flying foxes which roost there every day. These large fruit-eating bats leave the trees in the evening, and early in the morning may be seen returning to them in flocks. Their manner of attaching themselves to the branch is interesting. They fly just above it, hook their claws around it as they fly, apparently stumbling over it, swing back and forth for a few seconds, and then come to rest in a vertical position. They rest there all day in the hot sun, although at intervals one wakes up and disturbs his neighbors. The whole colony is aroused if one pounds on the buttress at the base of the trees, and then for a few minutes the air is black with thousands of them circling around their roost. Once during our visit the employees tried to frighten them away with a shotgun and one day kept them from having any sleep, but the next day the whole colony returned to its original place.

The only American species seen in the garden were the red cedar and the long leaf pine. Another plant was labelled *Rhus glabra*, but was clearly very different from our American sumac.

The vicinity of Peradeniya offers interesting landscape and mountain scenery, but has few attractions for the botanist.

All the land is planted to tea or used for the native villages and their accompanying rice fields. The shade trees used in the tea gardens at present are almost all Para rubber and the planter expects to get two crops from the same land, one of rubber and one of tea. It is doubtful whether this practice is a good one, for even here the altitude is too high for rubber and scarcely high enough for first-class tea. Other species of shade trees have been used in the past, especially eucalyptus and Australian oak, and a few specimens of these are still remaining.

Very little land is wasted in tea estates. There seems to be no soil too rocky nor no hillside too steep to be planted. Not far from the garden a huge boulder, almost an acre in extent, had one small pocket of soil almost in the middle and in this pocket five or six plants of tea were growing. There is some waste land along the river and at the edge of the native plantations, but this is occupied generally by the common weeds of the region and we really had no experience with the native flora of this part of Ceylon.

(To be continued)